



DRAFT STRATEGIC ASSET MANAGEMENT PLAN FOR WATER RESOURCES

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City of Burlington, Vermont

Abstract

This document provides a closer look at the steps and priorities needed for the Water Resources Department of the City of Burlington to develop and implement a successful Asset Management System and integrate it into the daily operations.

Hoyle, Tanner
& Associates, Inc.

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1. INTRODUCTION

In Phase 1A (Task 4) of the City of Burlington’s Asset Management Planning and Implementation, Hoyle, Tanner completed a *Preliminary Strategic Asset Management Planning Document (SAMP)* to summarize the findings of the interviews conducted during Phase 1A (Task 2) with different departments of the City of Burlington, and provide initial recommendations for the City to advance a city-wide asset management system. The document identified recommendations for gap closures and identified preliminary Levels of Service (LOS) and performance metrics. The purpose of Phase 1A was the following:

- To gain insight into the existing condition of the City Departments’ operation and management practices and policies
- Evaluate and analyze the strengths and deficiencies of existing programs
- Provide an assessment of shortfalls (gap analysis)
- Provide the City of Burlington with the framework of a plan to move forward

Building upon the efforts of Phase1A, Hoyle, Tanner has prepared this draft report as a more detailed *SAMP for the Water Resources Division* (Phase 1B – Task 1) that defines the asset classes to be further developed. The draft *SAMP for the Water Resources Division* also makes recommendations for prioritizations of asset management program development and identifies gap closures for the Water Resources Division to begin working on during the development of scopes for Phases II and III.

2. INVENTORY AND DOCUMENTATION OF EXISTING CONDITIONS

Using the information gathered from the surveys and conversations during the face-to-face interviews in Phase 1A (Task 2), Hoyle, Tanner gathered the information needed to assess the Water Resources Division’s current status along the asset management continuum. We also worked to identify any broad data gaps that would need to be considered during the Phase II portion of the project for each group.

The intent of the interviews was to understand the strengths and challenges of each group. During the interview process, we found that many of the groups already possess high levels of skill in their field and make use of the asset tools available to them. Through the use of the interviews, Hoyle, Tanner was able to determine what current programs each department has available to them and where each department is on the asset management continuum. The key take-away points of these interviews are summarized under “Current Asset Management Practices.”

A. Current Asset Management Practices

1. Water Resources – General Overview

Current Programs:

- KeepTrack at WWTPs
- ESRI Online – Stormwater and wastewater infrastructure is captured using “local government data” model
- PCSWMM – hydraulic sewer model
- RTA – used by “Store Keeper” at DPW for water parts and tools inventory

- Request for Service (RFS) – Work order form that was custom-built for City and Customer Service
- See, Click, Fix – Used by Customer Service
- AMANDA – Uses parcel info and is maintained by Planning Dept. (doesn't communicate directly with Flexibill)
- FlexiBill – Billing program for water, wastewater and stormwater
- Pavement Condition Index (PCI) – Pavement Management program is driving Water Resources projects, forcing increased coordination within DPW.

Current Asset Management Practices:

- Water Resource Division currently has no written policies for asset management.
- Water Division Capital Planning – The capital plan lists risk and consequence of failure (COF) scoring. (COF is only used at this time for water projects.)
- Asset management is still primarily reactionary, but has gotten better with coordination of projects with paving plan.
- When procuring assets, Water Resources has historically accepted the low bid. Now there is some flexibility to select non-low bid with justification.
- There may be the opportunity for the DPW “store keeper” to track wastewater and stormwater parts.
- The EMG reports evaluated Water Resources buildings (2014).
- Water Resources manages all Water Resources buildings, not Facilities.
- The Pipeline Assessment & Certification Program (PACP) is beginning to be used for sewer and stormwater drain video logging, and as such, Water Resources has developed a concept for standardized condition assessment for inventory data collection. This concept could be used for other assets besides sewer pipe.
- Water Resources is currently developing a complete inventory and condition assessment for vertical assets and developing a methodology for condition assessment of horizontal assets as part of a project called 20-year Capital Investment Plan and Gravity Pipe Assessment and Rehabilitation.
- Currently the City is working on a gravity pipe assessment project that will provide a thorough condition assessment baseline for the City's horizontal wastewater and stormwater assets. This information will provide a large amount of data which should be set up to be analyzed in the asset management software.
- Water Resources uses many different technical analysis tools in evaluating assets, such as PCSWMM hydraulic software for stormwater, wastewater, and watershed modeling. Water Resources also has a hydraulic model for the water system.
- Some electronic forms have been developed, such as a catch basin cleaning inspection form, sewer line cleaning form, and water breaks forms. Other forms still hardcopy, but will be developed electronically.
- WRD is interested in capturing data when doing routine work (i.e. photos of soils when digging any hole in City, hydrant flushing – time for water to run clear, etc.).
- Need policy for customer service, such as response time (based on type of identified issue), and use of social media to report issues, etc.
- Water Resources has a lot of historic paper files. Currently there is little interest in capturing these documents electronically, however WRD will capture electronic files moving forward.

- Sewer Spill Prevention Plan (2009), Emergency Response Plan (2004) – Earlier efforts could be beneficial to asset management program development (Standards of Practice (SOPs), contingency planning, COF concepts – customers impacted, etc.)

2. Water Division – Water Treatment Plant

Current Programs:

- Manager Plus (3rd version) – Maintenance program that generates work orders.
- SCADA system

Current Asset Management Practices:

- General inventory was completed in 2006, however no condition assessment has been performed on assets.
- Preventive maintenance schedule is based on calendar time, not run times. The SCADA system does not capture run hours of equipment. There is an opportunity to improve the preventative maintenance schedule by incorporating additional fields to make more robust.
- Use Manager Plus for work orders and inventory database, however, the program is currently only on one computer, is not backed up (high risk), and is no longer supported by the manufacturer.
- SCADA system has record keeping functionality.
- Building maintenance is not planned or scheduled, rather is performed on an as-needed basis.
- Culture of “run to failure” or near failure for equipment. System needs to work, so staff keeps the equipment going.
- There is Water Capital Plan for the Water Division for replacement of deficient items. The capital plan lists risk and consequence of failure (COF) scoring of the identified deficient items.
- Risk is managed by operations staff, i.e. redundancy, and the ability for Champlain Water District (CWD) to supply water to City if needed in an emergency.

3. Water Division – Water Distribution Group

Current Programs:

- GIS – The distribution system is starting to be mapped.
- Request for Service (RFS) is used to generate work orders and track maintenance.
- DigitCore – Correlator leak detection program on stand-alone laptop.

Current Asset Management Practices:

- The distribution system is being mapped in GIS. New lines, valves, curb stops are being mapped with GPS. Fields in GIS where notes such as material and size can be included are being incorporated.
- Historic maps of system have been scanned, but are of poor quality. These historic maps are being linked to assets using GIS.
- Maintenance records are all paper and are contained in log books.
- New water lines are sketched by hand with ties to features. The sketches are then scanned and linked thru GIS.
- Work orders are generated through RFS, but then printed out for work in field. The paperwork is handed back in for processing and billing.

- Inventory for Water Resources is handled by Department of Public Works Equipment Maintenance group, but is not tied to maintenance program.
- Inspection of private contractor work for private connections: The paperwork goes to Water Resources Billing department for processing and billing, and is then filed. Electronic copies of record drawings of private connections goes to the Water Resources Engineer.
- Condition Assessments: Starting to record types of break, but there is no assessment of hydrant flushing. All records are recorded on paper in flushing field books.
- Coordinating with next year's paving schedule to schedule preventive and corrective maintenance.
- COF: There is currently no formal way of looking at the consequence of failure. Water Distribution has started to install more valves on the longer runs to reduce the risk of a break. The next step is to look at areas that are vulnerable or where service is critical.

4. Water Division – Water Meters Group

Current Programs:

- Meter reading software: The meter readers use handheld "guns" to read meters from outside of building structures. There are roughly 9,000 radioed meters and 200 manually read meters in City. The guns download to computer for billing. The software includes fields for notes, but the meter readers can't see the notes from their gun screen.
- Request for Service (RFS) is used to generate work orders and track maintenance.

Current Asset Management Practices:

- Uncertainty if GIS maps being developed for the water distribution system include individual water meter ID numbers. Currently there is no communication between GIS and field crews handheld devices (meter reading guns).
- Work orders are generated from RFS from Water Resources Customer Service and Billing, but then printed out for work in field. The paperwork is handed back in for processing and billing. Maintenance is tracked on spreadsheet database.
- Inventory: Handled by Water Resources Customer Service and Billing in a spreadsheet database. The field crew documents inventory used in field and gives written paperwork to Water Resources Customer Service and Billing to input for invoicing and keeping track of inventory database.
- Historical Records: When the City changed out water meters back in the 1990's, they kept written records of the size and material of each house service. These records are kept in books.
- Condition Assessment: The field crew makes condition assessment notes on the paper work order for a property, which then gets tied to the property in the billing records. Meters can be damaged due to tampering, freezing inside a vacant property, gate valve getting stuck open, or from hydrant flushing. It takes two billing cycles to determine if there is a problem. When Water Resource Billing department notices there is 0 flow for a second month in a row, the property gets a notice. If there is extraordinary usage potentially indicating a break, Billing will flag and notify the property. Currently there is no way for the field crew to know flow history of meters when out in field reading meters.
- SOPs: There are currently no written policies, however they are being developed.
- An example of a good policy change was the rewriting of the Ordinance Chapter 31 on the replacement of the water meters. The old ordinance resulted in poor maintenance and cost to

customers, however, removing the requirement for the owner paying for the replacement meter only to get a higher water bill was a positive policy change.

- Challenges: locating service lines and up-to-date maps.

5. Water Resources - Customer Service and Billing

Current Programs:

- FlexiBill – billing program for water, wastewater and stormwater
- AMANDA – Uses parcel info and is maintained by Planning Department (doesn't communicate directly with Flexibill)
- Request for Service (RFS) – Work order form that was custom-built for Customer Service. It is used by Water Resources for service calls that require a site visit.
- Software program used for tracking material and labor projects and repairs. The program is no longer supported and will not be able to use post 2016.
- RTA – Meter inventory is managed by DPW at Pine Street using their RTA program.

Current Asset Management Practices:

- The current use of multiple programs, non-Water Resource calls and inquiries directed to DPW at Pine Street, only some data being captured in "comments" field in FlexiBill program (i.e. water quality (color, odor, taste)) are examples of early development.
- Early development of identifying benefits of an asset management program (i.e. potential to use program with meter calibration/testing effort).
- Meters not geo-referenced.

6. Wastewater Division

Current Programs:

- KeepTrack (Microsoft based program) – Only at Main WWTP and North WWTP for preventative and corrective maintenance management and scheduling. Program generates work orders monthly and keeps history on individual equipment, but does not have a condition assessment/criticality feature.
- Atlas v4.0 (old Windows 3.1 program, not upgradable) – Only at East WWTP. Maintenance program acts as inventory program and generate work orders.
- Excel Spreadsheets - for keeping track of inventory
- GIS – Video inspection of sewer for maintenance. Sections are inspected when cleaned and information is entered into GIS.
- SCADA – Stand-alone systems. East and North WWTP have touch screen PLCs. Main WWTP has Wonderware and is not linked to KeepTrack.
- CSO monitoring – 6 radio units around City. Not connected to SCADA.

Current Asset Management Practices:

- WWTPs General:
 - i. General inventory is complete, but no condition assessment of assets.
 - ii. Maintenance is tracked and scheduled in programs but based on calendar time, not run hours (SCADA does not communicate with programs).
 - iii. Maintenance programs used for work orders.

- iv. Building maintenance is not planned or scheduled, but performed as-needed.
- v. CoF: Redundancy and risk at WWTPs is managed by operations staff.
- Pump Stations:
 - i. Excel spreadsheets used to track maintenance and inventory, no scheduling tool, no condition assessment, and not connected to SCADA.
 - ii. Pump Stations are not linked to SCADA. No RTUs in stations, only horns and lights for alarms. Personnel collect data when they do rounds and use spreadsheets to keep track of maintenance.
- Collection System:
 - i. System is being mapped and data input into GIS when cleaned. The City is currently working on having a condition assessment/criticality feature tagged to manholes and lines as part of a separate project.
 - ii. CSO monitoring points have radio units, however they are not connected to SCADA.

3. PRELIMINARY GAP ANALYSIS

Table 1 – Preliminary Gap Analysis for City of Burlington’s Water Resources Division *Preliminary Strategic Asset Management Plan*, presented in Appendix A, is a summary of Hoyle, Tanner’s gap analysis and program development for the Water Resource Division. The table lists the gap identified in each area and provides a set of goals to guide the development and implementation of an asset management program. The first column of the table lists the criteria and objective for each area. The second column of the table addresses the Water Resources Division’s asset management gaps and goals to move forward. The third column of the table provides points and/or questions for consideration as the Water Resources Division moves forward with development of an asset management plan.

4. GOALS AND RECOMMENDATIONS

A. Goals for Asset Management Program Implementation

The following goals were previously identified in the preliminary *SAMP* as general goals for the Water Resources Division that will direct the development of the final *SAMP*.

1. General Goals for Water Resources Division

- Gather, keep current, and available asset data.
- Have a robust asset management system where data is up to date and entered once.
- Provide adequate training to make asset management a cultural part of everyone’s job.
- Adequate funding for the program.
- Develop better workflow from Service Calls, Work Orders, and Closeout.
- Reorganize staff/groups to improve efficiencies and share skill levels.
- Provide training and new technology to staff to perform their job.
- Provide transparency, promptness, real-time 24-hr/d updates, and use of social media for public communication.
- Develop a better understanding of consequence of failure associated with different assets.
- Have the right tools for staff to perform job and have access to data/information to make changes.

2. Specific Goals Identified for Water Resources Division

More specifically, each section within the Water Resources Division provided goals for asset management implementation:

a. Overall Goals Identified by Water Resources Division:

- To be able to gather data, have it available real-time, and keep it current.
- To be able to input data once into common robust asset management system.
- To have work orders assigned to assets.
- To have committed and trained staff.
- To have adequate funding.
- To be able to communicate effectively to public what DPW is doing.
- To have more city-wide, complete assessments of assets.
- To have effective expenditure of limited public dollars on assets.
- Identification of key performance indicators (i.e. miles of pipe cleaned, etc.)

b. Goals Identified by Water Treatment Plant:

- To have better work order execution
- To be able to retrieve data more efficiently.
- To have adequate resources for performance of work orders.

c. Goals Identified by Water Distribution Group:

- To be able to combine Water Distribution and Meter groups.
- To be able to see hydrant maintenance history, flow rates, flushing notes, etc. in GIS, so when a hydrant is looked up, personnel can see all the information and notes or observations of flushing events.
- To be able to link GIS maps to the leak detection system correlator sensors and have it linked to work orders.
- To have future hydraulic modeling potential for distribution system.
- To have GIS communication with work orders.

d. Goals Identified by Water Meters Group:

- To be able to combine Water Distribution and Meter groups.
- To be able to see in field the maintenance history, type of service, and valve type tied to each meter and property, as well as the history of usage to determine if property is vacant or if there is a break, if flushing has occurred on main, photo of meter, is there a pressure reducing valve, etc.
- To have information tied to work orders to be able to see historical information of each meter.
- To have a complete mapping system.
- To have communication with Code Enforcement/Fire Dept regarding vacant buildings tied to meters.

e. Goals Identified by Water Resources Customer Service and Billing:

- A system that meets customer's new and expanding expectations for customer service.
- Heightened expectations for transparency, promptness, real-time 24-hr/d updates, use of social media

- The potential for new Public Information Officer who would be responsible for communicating with public, allowing existing staff to focus on job responsibilities.
- To have better Water Resources infrastructure so that there are less water breaks and less water quality issues.
- To have more definite/accurate responses for customer inquiries (i.e. project timing)

f. Goals Identified by Wastewater Division:

- Atlas v4.0 is outdated and data retrieval is a problem. It needs to be completely replaced. Would like to be able to export data into KeepTrack program.
- To be able to add condition assessment and COF capability to maintenance program.
- To be able to export run times from SCADA into maintenance program.
- To be able to link pump stations to respective WWTP SCADA systems and maintenance programs to be able to control and monitor alarms, run times, condition assessments, COF, etc.
- Develop SOPs and have Emergency Response Procedures, Lock-Out/Tag-Out procedures, MSDS sheets linked, as well as pertinent O&M Manual information.
- To use GIS and camera to develop ranking system based on COF. Develop corrective and preventative maintenance (point repair or pipe lining) schedule and have coordinated with Street Paving Schedule.
- To have the asset management program tied in with Building Evaluations, 20-yr Evaluation, and Sludge Dewatering Upgrade.
- To have an easier way to get information and to collect data.

B. Recommendations

1. Opportunities for Improvement

Water Resources is currently in the best position to implement an asset management program. There is strong leadership level support and understanding. Our review of current practices identified several opportunities to strengthen the Water Resources Division asset management capabilities and processes. Opportunities for improvement that were identified in the previous *Preliminary SAMP* included the following:

Organizational

- Water Resources has maintenance records and work history on the City's vertical assets, but there is still a great need to develop condition assessments, maintenance records and work history on the City's horizontal assets.
- Water Resources should develop more efficient ways to capture day to day operations linked to assets.
- Communication and data sharing between departments throughout the City should to be priority with proper protocols.

Tools

- Water Resources should use better analytical tools to manage their assets. There are many types of tools that provide predictive maintenance, as well as tools that help analyze the data collected.

Examples of such tools range from infrared analysis of the electrical connections to tracking life cycle cost through the asset management program.

Policies

- Budgets for asset investments are not clearly linked to performance, or measureable metrics.
- There is no system or process in place to manage assets to the lowest life-cycle cost.
- Target Levels of Service for critical Water Resource assets should be developed. A target level of service is the minimum expectation of a specific asset, where if the asset falls below that target, it is no longer considered beneficial (i.e. level of service for SCADA system, or level of service hydrant flushing).
- System Levels of Service should be developed for Water Resources. A system level of service is broad in nature (i.e. only 20 breaks per year for every mile of water line).

Culture

- Project level capital decision making should be more data driven.
- Improvements can be made to make asset investment decisions more transparent.
- LOS should be defined and measurable.

2. Actions for Water Resources

The previous *Preliminary SAMP* document, recommended general actions be taken by the City of Burlington to further the implementation of an asset management program. Several of these actions apply directly to the Water Resources Division, including the following:

- That condition surveys be undertaken for all asset categories, including safety and risk assessments, identification of remaining useful life and determination of appropriate treatments.
- That service levels are established for each asset category for unscheduled and routine maintenance and renewal programs, including optimum funding levels required to match desired service levels and minimize risk exposure.
- That valuation of identified assets is completed.
- That risks associated with each asset category are identified and assessed, including determination of costs to remedy.
- That individual Asset Management Plans for each asset category are developed.

3. Prioritization for Asset Management Implementation

a. Horizontal Assets

The Water Resources Division should prioritize the development of its horizontal assets for an asset management program. Horizontal assets include the water distribution system pipes and water meters, the sanitary sewer collection system, and the stormwater collection system.

The reasons for implementing an asset management program for the Water Resources Division's horizontal assets first include the following:

- Horizontal assets are not visible as they are located underground. As such, the consequence of failure of any of the horizontal assets is high with the greatest potential for financial, environment, and social costs and impacts.
- The Water Resources Division is still learning the location, condition, and maintenance needs of its horizontal assets.
- The Water Resources Division does not have a work order system linked to specific assets.
- Horizontal assets have impacts on other related assets, such as roads, pavement, and sidewalks for example.

b. Vertical Assets

The second tier for asset management program integration is the Water Resources Division's vertical assets which include the water treatment plant, water storage reservoirs, wastewater treatment plants, and wastewater pumping stations.

The reasons for implementing the vertical assets after the horizontal assets include the following:

- Vertical assets are visible as they are located above ground. The Water Resources Division can respond quickly to problem or deficiencies associated with a vertical asset.
- Most of the vertical assets, such as the water treatment plant or the wastewater treatment plants, have redundancy and contingencies in place reducing the potential for financial, environment, and social costs and impacts in the case of failure.
- The Water Resources Division currently has a Computer Maintenance Management System (CMMS) and is already capturing and inputting data, and maintaining an inventory on the vertical assets.

4. Next Steps for Water Resources

The Water Resources Division should begin by following the steps outlined below:

- a. Clearly defining each of the asset classes within the Water, Wastewater, and Stormwater departments, and separating these into horizontal and vertical assets.
- b. Beginning with the horizontal assets, refer to Table 1 - Gap Analysis for the Water Resources Division presented in Appendix A for points and questions for consideration to further develop the Water Resources Division Asset Management Plan.

APPENDIX A

TABLE 1 - GAP ANALYSIS FOR WATER RESOURCES DIVISION

TABLE 1 –GAP ANALYSIS for CITY OF BURLINGTON’S WATER RESOURCES DIVISION STRATEGIC ASSET MANAGEMENT PLAN

Asset Management Policy		
Business Practice Characteristics	Water Resources Division Gap Analysis	Questions to Guide Further Development
Define Goals and Objectives: Goals and objectives are comprehensive, integrated with other City’s policies, and supported by quantitative and measurable performance criteria.	Water Resources should define their mission, goals and objectives and make sure they align with the City’s goals & objectives.	Questions to consider: <ul style="list-style-type: none">• How can the goals of the Water Resources be pulled together so that it becomes a common vision?• How does new regulation impact these goals?• How does resource, training and communication effect meeting these goals?• If there were additional funds how should they be used to help meet the goals?
Assets Purchasing Based on Life Cycle Costing: Principles are outlined in the purchasing policy to drive decisions based on life cycle economic analysis of the asset performance and cost, and encourage strategies with long-term benefits.	Water Resources should identify the life cycle cost attributes to provide measurable and quantitative data in the purchasing of assets. Water Resources should develop specifications and an evaluation process based on life cycle analysis and performance. This will support city-wide purchasing and evaluation policies. An example of this would be water meter replacement policy where lost revenue increases the life cycle cost.	Questions to consider: <ul style="list-style-type: none">• How is the knowledge and understanding of the real cost of an asset captured?• When a new asset is acquired, what information is put together to start tracking its life cycle cost?• What are the most important things that are looked at when purchasing a new asset?
Policy Formulation Allows Latitude in Arriving at Performance Driven Decisions on Resource Allocation: Provide information on which driving factors for assets dictate the investment of associated assets.	Water Resources currently allows the Pavement Condition Index of the street assets to drive prioritization of investments in the water distribution, sewer, and stormwater collection systems. A policy should be developed to evaluate assets using risk to drive the capital investment of associated assets during integration with the Street Paving program, as well as assets on streets outside the paving program.	Questions to consider: <ul style="list-style-type: none">• How should the process for new investments change?
Engagement with Policy Makers: The staff actively engages with political leaders and other policy makers to define expectations of the infrastructure.	Water Resources may be the leading group in the development of policies that provide the information to the decision makers. Water Resources should be actively engaged with policy maker and provide the information necessary to support policies.	Questions to consider: <ul style="list-style-type: none">• When developing policies or ordinances, how much involvement does Water Resources have with the policy maker?• When a policy does not meet the needs of the organization, is it a difficult process to change?• Does policy effect the way work is performed on a day-to-day basis?
Prioritizing Capital Investment Projects Based on Risk: Capital project should start by managing high risk assets through investment process.	Water Resources should look at these investments using asset management principles. The staff currently analyzes risk (though often informally) when making capital investment decisions. This process needs to be formalized/developed and standardized across different assets.	Questions to consider: <ul style="list-style-type: none">• In development of the priority of capital investment project, is risk the controlling factor?• If it is risk, what are the factors that are looked at?
Capital Investments are Based on Added Level of Service and is Measurable: Each capital investment will have a measurable level of service and be able to be evaluated based on expectations.	Water Resources should develop their capital investment program to include measurable levels of service that are developed as part of the asset management program. Water Resources capital investments need to meet the required level of service expected by the customers and regulatory agencies.	Questions to consider: <ul style="list-style-type: none">• When an asset investment is being developed, how is the expectation of the project developed?• Is the expectation measurable? How is it determined if the investment has been successful?

TABLE 1 –GAP ANALYSIS for CITY OF BURLINGTON’S WATER RESOURCES DIVISION STRATEGIC ASSET MANAGEMENT PLAN

	Business Practice Characteristics	Water Resources Division	Questions to Guide Further Development
Asset Information System	Inventory: Maintains an inventory of assets that is a complete and accurate.	Water Resources should work with the City to develop standards for the collection and maintenance of their inventory. The development of basic inventory has been conducted, and attribute data input is currently underway.	Questions to consider: <ul style="list-style-type: none"> What are the methods used for maintaining inventory? What information is collected on the asset? How is inventory kept current? When a new development is taken over, are record drawings obtained, and are they in a format that goes into the inventory?
	Workflows: Development of standard operating procedures (SOPs) throughout the organization to create continuity and capture information.	Water Resources should maintain and develop workflows/SOPs as part of everyday operations so the development of minor changes will allow the asset management program to grow and expand its information and data. Training in both the development and execution of workflow/SOPs is necessary so that they can easily be employed by Water Resources staff.	Questions to consider: <ul style="list-style-type: none"> What is provided for new employees when they start work? What training is involved with both new and existing employees? Are there jobs that are done infrequently, and who does these jobs? Are there ways to carry the knowledge on to the next person?
	Condition: Asset condition data is updated on a periodic schedule sufficient to provide information to develop deterioration curves to provide timely and accurate information on the status and performance of an asset to allow for meaningful data-driven decision making.	Water Resources currently uses standards for condition assessment of some of their asset types, including PACP for sewer and stormwater pipes. Utilizing this training of condition evaluation standards will help in the development of additional assessment standardization assets. Water Resources should start by developing condition assessments for horizontal assets with a useful life of 25 years or greater, such as the sanitary sewer collection system. Assets with a useful life less than 25 years, such as mechanical equipment, should be limited to inspection standards allowing prioritization of assets requiring condition assessment.	Questions to consider: <ul style="list-style-type: none"> Think of examples of an asset in good shape, poor shape, and one that is in normal condition. What does “condition” mean, and does it mean the same to someone else? Develop a standardization for measuring condition. What is the process to determine when it is time to replace an asset? An analogy would be the thought process one goes through when one decides it is time to replace a vehicle.
	Consequence of Failure: Consequence of failure provides a risk standard for each of the assets based on financial, environmental and social impacts of failure.	Water Resources should start incorporating the asset’s consequences of failure into the evaluation process and condition assessment. By understanding and evaluating how an asset will fail and the associated consequences of that failure, Water Resources will be able to prioritize assets by risk tolerance and create a risk tolerance ranked list of priorities. By focusing on the high risk assets, Water Resources can employ effective strategies to reduce the City’s risk.	Questions to consider when evaluating COF: <ul style="list-style-type: none"> What are examples of high risk assets? Give an example of a high consequence failure, and why was it considered to be high? What is the biggest concern if this high risk asset fails? What is the best thing that can be done to minimize this risk?
Maintenance	Tracking Life Cycle Cost: Life Cycle Cost has an impact on many of the decisions in the management of assets. The workflow throughout the life of an asset will capture all the costs from initial purchase, operation and maintenance, down time and societal cost of inoperation, environmental cost, and disposal.	Water Resources should have the tools to capture the information needed to evaluate life cycle cost. This will allow the capture of the initial purchase, installation, operation and maintenance, societal, and disposal cost in the program to support better decision making.	Questions to consider when evaluating Life Cycle Costs: <ul style="list-style-type: none"> How is the operational cost of an asset captured, and is it looked at it on a yearly basis? Is there a way to evaluate performance and lowest life cycle cost? If there is not a way, how should it be done?

TABLE 1 –GAP ANALYSIS for CITY OF BURLINGTON’S WATER RESOURCES DIVISION STRATEGIC ASSET MANAGEMENT PLAN

	Business Practice Characteristics	Water Resources Division	Questions to Guide Further Development
Level of Service	Develop Levels of Service Required for Different Asset Classes (System-Wide): Assets exist to deliver services and goods that are valued by customers; for each customer there is a minimum level of service below which a given service is not perceived as adding value. Additionally, higher levels of service than what customers are willing to pay for may not be cost-effective for the City to continue to provide.	Water Resources should develop a level of service for all asset classes within the Water, Wastewater, and Stormwater departments. The minimum level of service required by regulatory, performance and response requirements, as well as customer expectations, health and safety, and financial requirements should define the level of service to be provided, performance measured, and target level.	Questions to consider: <ul style="list-style-type: none">• Do regulatory requirements have minimum requirements, and how are these requirements met?• What asset is measured to know if these requirements are being met?
	Development of Target Levels of Service for Assets Based on Different Types, Locations, and Customers: “Target Service Levels” provide guidelines for the organization to use when establishing the annual maintenance work program, emergencies and service responses, project selection, and budget development.	Water Resources should develop Target Levels of Service for the major assets classes (catch basins, intakes, pump stations, gate valves, water mains, etc.) within the system. These target levels of service will vary by location, usage, age, customer and environment. The levels of service standard provides a description of the criteria which will be used to establish the level of funding that will need to be provide to maintain the asset.	Questions to consider: <ul style="list-style-type: none">• Is the level of service linked to the budget for operation and maintenance?• What things can be done to provide a higher level of service without additional funds?
Training	Customer Perceptions: Customer perception information is collected and updated through surveys, focus groups, complaint tracking, etc. to gauge the perception of asset condition and performance. This methodology allows for the identification of the service aspects customers value.	Customer perception of Water Resources is that this division has better workflows providing a better perception of the asset performance by customers. Water Resources should link services calls to asset and Levels of Service.	Questions to consider: <ul style="list-style-type: none">• What training is provided to deal with customers?• Is there any information developed to give customers for routine service calls and small projects?• When doing a large project, is customer communication include as part of the project?
	Investment in the Staff is an Investment in the Assets: The international standards for asset management include the need for training and investing in staff.	Water Resources should create opportunities for personnel to share among the group. Water Resources should develop SOPs to capture information and develop workflows and tasks to improve quality and quantity of work being completed. This will also allow evaluation, improvements of procedures, and provide education to new employees.	Questions to consider: <ul style="list-style-type: none">• What training or certifications are required in the field of work?• How does one keep current?